Supporting Information

Manuscript Title:

Atmospheric Particulate Matter Pollution during the 2008 Beijing Olympics

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Table SI 1. Pearson correlation coefficients between particulate matter concentrations (all p-values <0.001). Con_{PKU} is the PM_{10} concentration we measured at PKU. Con_{WL} and Con_{OC} are the Beijing EPB API data converted to PM_{10} concentrations at Wanliu (WL) and the Olympic Center (OC), respectively. $Con_{Beijing}$ is the average Beijing EPB API data converted to average PM_{10} concentrations for Beijing. $Con_{5\text{-}Ring}$ is the average Beijing EPB API data converted to average PM_{10} concentrations for all urban sites within the 5-Ring Road of Beijing.

	$>PM_{10}$	$PM_{2.5\text{-}10}$	$PM_{2.5}$	Con_{PKU}	Con_{WL}	Con_{OC}	$Con_{Beijing}$	$Con_{5\text{-}Ring}$
$>PM_{10}$	1							
$PM_{2.5\text{-}10}$	0.905	1						
$PM_{2.5}$	0.789	0.861	1					
Con_{PKU}	0.841	0.920	0.991	1				
Con_{WL}	0.872	0.944	0.924	0.954	1			
Con_{OC}	0.856	0.931	0.930	0.956	0.983	1		
$Con_{Beijing}$	0.848	0.932	0.936	0.961	0.990	0.993	1	
$Con_{5\text{-}Ring}$	0.856	0.932	0.917	0.946	0.987	0.992	0.995	1

Table SI 2. Daily and Annual $PM_{2.5}$ and PM_{10} Chinese, US and WHO concentration standards.

		Daily		Annual	
		PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)
Ambient Air Quality Standards of China (CAAQS) (1996) [a]	Grade I	50		40	
	Grade II	150		100	
	Grade III	250		150	
National Ambient Air Quality Standard (NAAQS) of the United States (2007) [b]		150	35	Revoked	15
Air Quality Guideline (AQG) of World Health Organization (WHO) (2005) [c]		50	25	20	10

[a] Chinese Standard: Ministry of Environmental Protection of China, 1996. Ambient air quality standard. (http://www.nthb.cn/standard/standard03/20030411161748.html).

[b] US standard: US Environmental Protection Agency (US EPA) (http://www.epa.gov/pm/ standards.html)

[c] WHO Standard: World Health Organisation (WHO), Air Quality Guidelines – Global Update, 2005, WHO, 2006

Table SI 3. Spearman correlation coefficient between PM concentrations and SRIF (South, Northwest, Northeast, East of Beijing)

		$>PM_{10}$	$PM_{2.5-10}$	$PM_{2.5}$	PM_{10}	Con_{WL}	Con_{OC}	$Con_{Beijing}$
$SRIF_{South}$	Source Control Time (n=46)	0.436**	0.563**	0.683**	0.677**	0.625**	0.619**	0.643**
	Non-Source Control Time (n=17)	0.639*	0.661**	0.825**	0.789**	0.725**	0.801**	0.761**
	Entire data set (n=63)	0.380**	0.489**	0.639**	0.612**	0.544**	0.591**	0.586**
$SRIF_{Northwest}$	Source Control Time (n=46)	-0.187	-0.280	-0.472**	-0.456**	-0.349*	-0.376*	-0.395*
	Non-Source Control Time (n=17)	-0.629*	-0.629*	-0.843**	-0.800**	-0.668**	-0.755**	-0.711**
	Entire data set (n=63)	-0.155	-0.232	-0.416**	-0.382**	-0.280*	-0.350**	-0.339*
$SRIF_{Northeast}$	Source Control Time (n=46)	-0.140	-0.300	-0.250	-0.262	-0.305	-0.262	-0.306
	Non-Source Control Time (n=17)	0.101	0.149	0.159	0.166	0.223	0.163	0.172
	Entire data set (n=63)	-0.077	-0.156	-0.158	-0.146	-0.162	-0.150	-0.171
$SRIF_{East}$	Source Control Time (n=46)	-0.188	0.003	0.081	0.079	-0.021	0.010	0.021
	Non-Source Control Time (n=17)	-0.186	-0.186	0.062	0.000	-0.124	.000	-0.062
	Entire data set (n=63)	-0.185	-0.078	0.023	0.009	-0.084	-0.028	-0.036

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table SI 4. Spearman correlation coefficient between PM concentrations and meteorological variables, “Precip” is the precipitation amount for the sampling day and “Precip (Prior day)” is the precipitation amount for the day prior to the sampling day.

		>PM_{10}	$PM_{2.5-10}$	$PM_{2.5}$	PM_{10}	Con_{WL}	Con_{OC}	$Con_{Beijing}$	$SRIF_{South}$	$SRIF_{Northwest}$	$SRIF_{Northeast}$	$SRIF_{East}$
Wind speed	Source Control Time (n=46)	-0.169	-0.175	-0.215	-0.217	-0.112	-0.119	-0.095	-0.135	0.149	-0.122	-0.089
	Non-Source Control Time (n=17)	-0.479	-0.500	-0.407	-0.429	-0.532*	-0.544*	-0.504	-0.402	0.275	-0.051	-0.153
	Entire dataset (n=63)	-0.233	-0.248	-0.261	-0.276*	-0.225	-0.255*	-0.224	-0.219	0.181	-0.111	0.087
Sin Wind direction	Source Control Time (n=46)	0.010	0.175	0.283	0.285	0.254	0.301	0.314*	0.370*	-0.495**	-0.017	0.416**
	Non-Source Control Time (n=17)	0.693**	0.664**	0.550*	0.579*	0.661**	0.608*	0.632*	0.321	-0.150	0.529*	-0.309
	Entire dataset (n=63)	0.233	0.364**	0.357**	0.372**	0.414**	0.413**	0.430**	0.325**	-0.376**	0.090	0.282*
Cos Wind direction	Source Control Time (n=46)	-0.253	-0.342*	-0.503**	-0.467**	-0.406**	-0.417**	-0.433**	-0.270	0.291	0.055	-0.116
	Non-Source Control Time (n=17)	-0.229	-0.354	-0.154	-0.196	-0.389	-0.365	-0.400	-0.096	.007	0.042	0.247
	Entire dataset (n=63)	-0.243	-0.315*	-0.388**	-0.375**	-0.388**	-0.409**	-0.421**	-0.278*	0.203	0.057	-0.062
Temperature	Source Control Time (n=46)	0.306	0.418**	0.512**	0.499**	0.516**	0.525**	0.535**	0.095	-0.138	-0.086	0.212
	Non-Source Control Time (n=17)	0.071	-0.039	0.225	0.143	-0.036	0.055	0.061	0.321	-0.350	-0.229	0.306
	Entire dataset (n=63)	0.071	0.098	0.198	0.170	0.198	0.249*	0.239	0.343**	-0.443**	0.043	0.437**
Precip	Source Control Time (n=46)	-0.487**	-0.224	-0.167	-0.192	-0.290	-0.253	-0.234	0.151	-0.188	-0.043	0.353*
	Non-Source Control Time (n=17)	-0.564*	-0.472	-0.325	-0.335	-0.339	-0.253	-0.293	-0.073	0.164	0.315	0.478
	Entire dataset (n=63)	-0.507**	-0.291*	-0.192	-0.224	-0.336**	-0.291*	-0.276*	0.145	-0.177	0.041	0.329**

Precip (Prior day)	Source Control Time (n=46)	-0.459**	-0.480**	-0.430**	-0.436**	-0.371*	-0.359*	-0.377*	-0.185	0.152	-0.040	0.184
	Non-Source Control Time (n=17)	-0.574*	-0.615*	-0.636*	-0.640*	-0.645**	-0.698**	-0.711**	-0.431	0.536*	-0.172	-0.158
	Entire dataset (n=63)	-0.497**	-0.533**	-0.487**	-0.501**	-0.454**	-0.433**	-0.449**	-0.200	0.148	-0.048	0.151
Relative Humidity	Source Control Time (n=46)	-0.134	-0.006	0.049	0.048	-0.089	-0.094	-0.087	0.431**	-0.466**	0.063	0.488**
	Non-Source Control Time (n=17)	0.418	0.496	0.493	0.511	0.561*	0.587*	0.550*	0.522*	-0.387	0.330	0.408
	Entire dataset (n=63)	0.042	0.157	0.207	0.214	0.087	0.107	0.097	0.451**	-0.421**	0.124	0.395**
Relative Humidity (Excluding rain day)	Source Control Time (n=46)	0.192	0.292	0.378*	0.386*	0.266	0.232	0.246	0.595**	-0.590**	0.025	0.477*
	Non-Source Control Time (n=17)	0.566*	0.654*	0.462	0.522	0.659*	0.636*	0.643*	0.455	-0.266	0.169	N.A.
	Entire data set (n=63)	0.311*	0.400**	0.413**	0.450**	0.383**	0.391**	0.385**	0.529**	-0.445**	0.048	0.309*

** Correlation is significant at the 0.01 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed)

Table SI 5. R^2 for the three models: (1) Meteorology only ($SRIF_{south}$ + Precip, 2 degrees of freedom); (2) Source control only (Oly + SC_{nonOly} + NSC, 2 degrees of freedom); and (3) Full Model ($SRIF_{south}$ + Precip + Oly + SC_{nonOly} + NSC, 4 degrees of freedom)

	Meteorology only	Source control only	Full Model
$>PM_{10}$	0.24	0.14	0.36**
$PM_{2.5-10}$	0.25	0.18	0.45**
$PM_{2.5}$	0.43	0.14	0.55**
Con_{PKU}	0.40	0.16	0.55**

** p-value < 0.01

Table SI 6. PM_{10} concentration ($\mu g/m^3$) in Beijing and other Olympic cities

	Atlanta (1996) [a]	Sydney (2000) [b]	Athens (2004) [c]	PKU (2008) [d]	$Con_{Beijing}$ (2008) [d]
Before Olympics (one month)	39.5	13.8	48.5	143.3	90.6
During Olympics	28.1	23.7	44.3	82.4	53.7
After Olympics (one month)	38.3	17.0	53.4	118.3	80.0

[a] Air Protection Branch of EPA, Georgia
[b] http://www.environment.nsw.gov.au/AQMS/aqi.htm
[c] http://www.minenv.gr
[d] our research

Table SI 7. The average Beijing EPB PM_{10} concentrations in October, November, and December 2007 and 2008, as well as Olympic, Non-Olympic, source control and non-source control periods of 2008. NA = data not available.

	2008							2007		
	Olympic (n=17)	Non-Olympic (n=46)	Source Control (n=46)	Non-Source Control (n=17)	October (n=31)	November (n=30)	December (n=31)	October (n=31)	November (n=30)	December (n=31)
$Con_{WL}(\mu g/m^3)$	53.4±26.4	86.8±47.3	73.3±37.6	89.9±60.5	110.0±64.4	126.7±80.4	154.9±94.3	NA	NA	NA
$Con_{OC}(\mu g/m^3)$	54.6±29.7	84.1±49.5	73.0±40.1	84.5±61.9	105.8±69.3	116.1±74.5	151.5±97.5	NA	NA	NA
$Con_{Beijing}(\mu g/m^3)$	53.7±28.3	82.6±47.0	71.6±38.0	83.2±59.2	103.0±65.2	112.0±70.4	144.7±91.4	112.8±76.9	153.3±102.4	198.0±137.9

Figure SI 1. The location of auto-monitoring sites used by the Beijing Environmental Protection Bureau (EPB) and the location of our air monitoring site at Peking University (PKU).

Filter Mass Correction for Humidity

Because the relative humidity is high in Beijing during the summer months, we corrected for the increase in filter mass that resulted from high humidity levels. A subset of the filters (~33%) was weighed before and after sample collection, and before and after dessication for 24 hours, in accordance with USEPA Method 5 of 40 CFR Part 60 (http://www.epa.gov/ttn/emc/methods/method5.html). Only a subset of samples was tested by dessication and the filters were not dried at 105 ^{o}C after sample collection in order to minimize analyte loss and/or sample contamination that would affect subsequent semi-volatile organic compound analysis of the filters. The percent change in filter mass was then correlated with the ambient relative humidity during the sampling period and this linear regression was used to correct the PM mass of all filters using the following equations (Figure S1):

For >PM_{10} Filters:

$$\frac{M_{before} - M_{after}}{M_{before}} \times 100\% = 0.0015 \times [\text{Relative Humidity}] - 0.0796,\ p\_\text{value}=0.0044,\ R^2 = 0.4066$$

For $PM_{2.5\text{-}10}$ Filters:

$$\frac{M_{before} - M_{after}}{M_{before}} \times 100\% = 0.0036 \times [\text{Relative Humidity}] - 0.2155,\ p\_\text{value}=0.0001,\ R^2 = 0.7356$$

For $PM_{2.5}$ Filters:

$$\frac{M_{before} - M_{after}}{M_{before}} \times 100\% = 0.0030 \times [\text{Relative Humidity}] - 0.1646,\ p\_\text{value}=0.0001,\ R^2 = 0.6624$$

Here, M_{before} is the filter mass before the filter was put in the drying desiccator; and M_{after} is the filter mass after the filter was put in the drying desiccator for 24 hours.

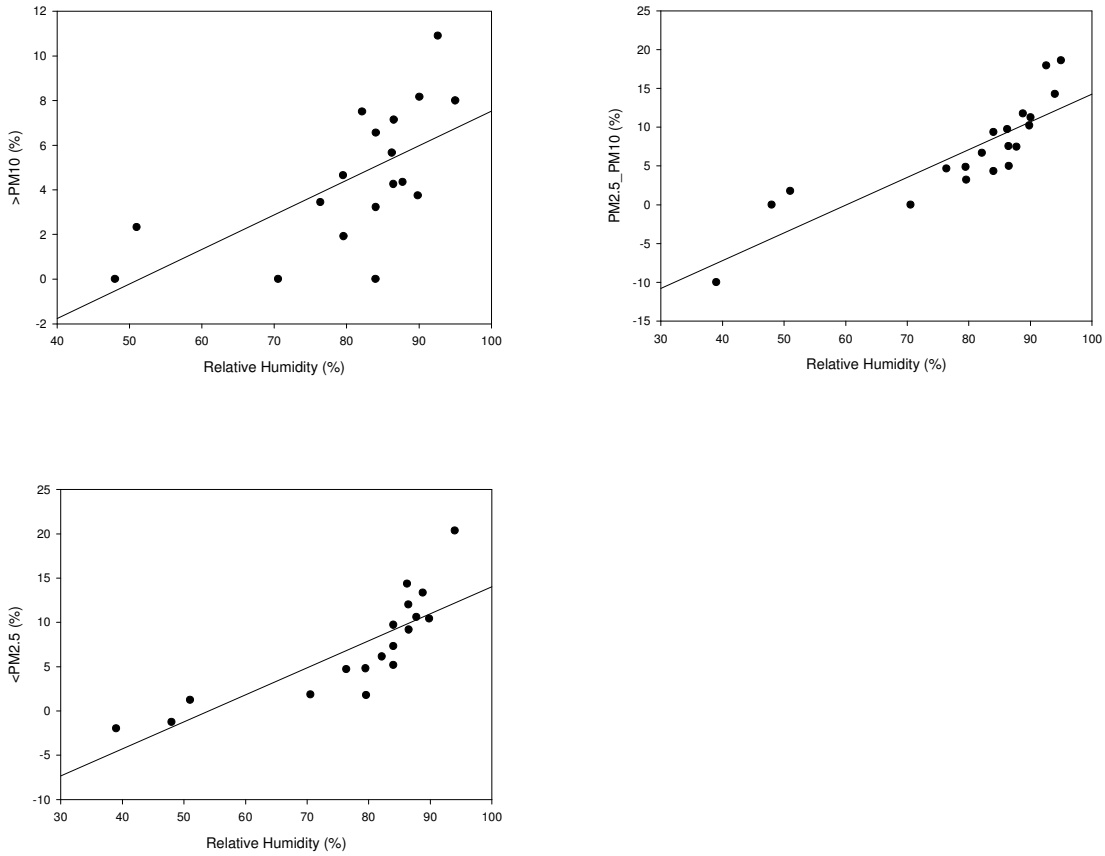

Figure SI 2. Regression between the change in filter mass after drying and relative humidity for >PM_{10}, $PM_{2.5-10}$, $PM_{2.5}$.

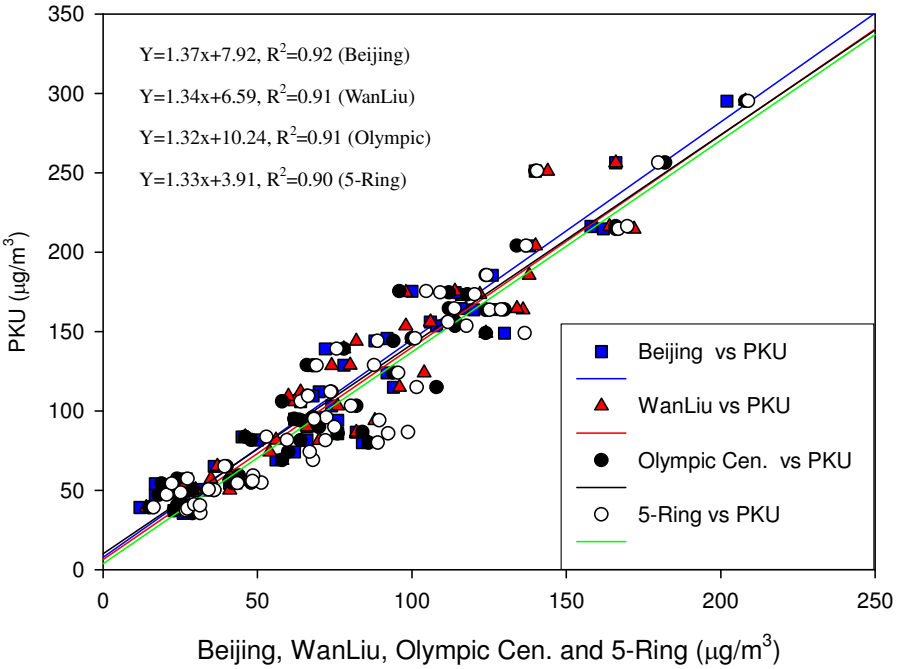

Figure SI. 3. Correlation between PKU PM_{10} concentrations and Beijing EPB PM_{10} concentrations (n=63).

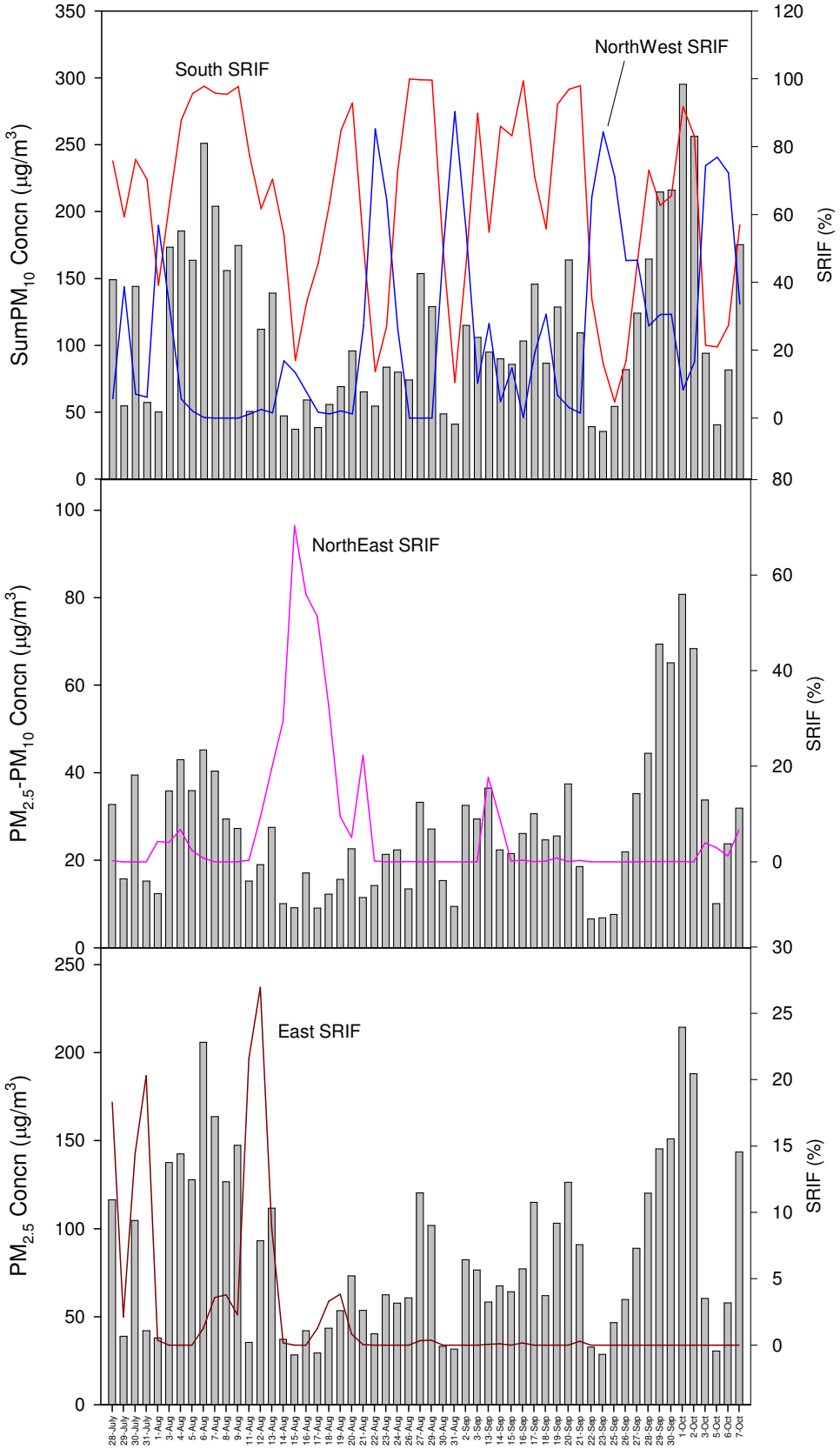

Figure SI 4. Temporal variation of PKU PM_{10}, $PM_{2.5\text{-}10}$, and $PM_{2.5}$ concentrations and SRIFs (South, Northwest, Northeast and East)